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THE CATALOGUE OF THE JAPANESE TIPULIDAE, WITH THE KEYS TO THE GENERA AND SUBGENERA (Diptera)

VI. LIMONIINAE, TRIBE ERIOPTERINI (1)

Hiroshi Ishida

List of Abbreviations (II)

AH :- Archiv für Hydrobiologie, Suppl.-Bd. IX, "Tropische Binnengewässer Band II"; AN :- Archiv für Naturgeschichte; CI :- Classification of Insects, Hokuryûkan, Tokyo; CIS:- Catalogus Insectorum Sinensium; DS :- Diptera Scandinaviae; JMM :- Journal of the Federated Malay States museums; KB :- Konchû Bunruigaku, Keiseisha-shoten, Tokyo; KPD :- Katalog der paläarktischen Dipteren; MPMM :- Miscellaneous Publications of the Museum of Zoology, University of Michigan; VZBG :- Verhandlungen der Zoologisch-botanischen Gesellschaft in Wien; WEZ :- Wiener entomologische Zeitung; ZA :- Zoologischer Anzeiger; 6000 :- 6000 Illustrated Insects of Japan-Empire, Tôkôshoin, Tokyo.

Big.:- Bigot; Curt.:- Curtis; Dalm.:- Dalman; Goetg.:-Goetghebuer; Hoffm.:-Hoffmannsegg; Kol.:- Kolenati; Lundst.:- Lundstroem; Merg.:- Mergerle; Phil.:- Philippi; Ried.:- Riedel; Shir.:- Shiraki; Tok.:- Tokunaga.

alt.:- altitude; ft.:- feet; *:- Original not seen; †: According to Dr. C. P. Alexander.

Tribe **ERIOPTERINI**

Eriopterini, Brun.: FBI, 357, 436-40 (1912); Alex.: PUNM, 44:491, 492 (1913); MCAS, 25:890, 901-2 (1919); PUNM, 58:392, 416 (1920) (with McAtee); MCAS, 38:794, 795, 908-11 (1920) [L; P]; FG, 43, 48-52 (1934); BCSS, 64:297, 424-6 (1942); Pierre: FF, 8:69, 91-2 (1924); Coe: HIBI, 22, 45-7 (1950).

Limnobiinae eriopteraeformes, O. S.; Schin.: FA, 2:xxvii, 535 (1864).

Eriopterina, O. S.: MD, 4:46-7, 135-8 (1869); BEZ, 31:191-2 (1887); Skuse: PLSN, (2) 4: 799-800 (1890).

Eriopterinae, Kert.: KPD, 1:289 (1903); End.: TM, 17, 19-21 (1936); Lacks.: ANMW, 50:10 (1940); Shir.: CI, 642, 643-4 (1954).

Chioneidae, Rond.: PDI, 1:38 (1856).

Chioneina, Rond.: PDI, 1:38, 189 (1856).

Limnobina anomala, part, O. S.: MD, 4:46, 100-1 (1869); BEZ, 31:183 (1887); Skuse: PLSN, (2) 4:787-8 (1890).

Antochini, part, Alex.: *Psyche, 20:40-1 (1913); PUNM, 44:491 (1913); MCAS, 25:890, 897 (1919); PUNM, 58:392, 413-4 (1920) (with McAtee).

Antochinae, part, Shir.: CI, 642 (1954).

Crypterini, part, Pierre: FF, 8:69, 113 (1924).

Crypterinae, part, End.: TM, 17, 21 (1936); Shir.: CI, 642 (1954).

Key to Genera and Subgenera

(Including Hexatomine genera without tibial spurs.)

1. Nearly apterous species, the wings reduced to microscopic structure that are smaller than the halteres. ····· **Chionea**
   Fully-winged species. ····· 2
2. Wings with cell M_1 present. ····· 3
   Wings with cell M_1 lacking. ····· 6
3. Apical cells of wing with macrotrichia. ····· ····· [**Paradelphomyia (Oxyrhiza)**]
   Cells of wing without macrotrichia. ····· 4
4. Wings with *r-m* distinctly beyond cell *1st* M_2. ····· **Conosia**
   Wings with *r-m* at the beginning of, or over the middle of, the cell *1st* M_2, in the absence of cell *1st* M_2, at the base of cell M_2. ····· 5
5. Wings with R_{2+3+4} subequal to or longer than vein R_3, cell R_3 thus being subequal to its petiole; vein R_2 at or before fork of R_{3+4}. ····· ····· **Neolimnophila**
   Wings with R_{2+3+4} shorter than vein R_3, cell R_3 being much longer than its petiole; R_2 far beyond fork of R_{2+3+4} ····· **Cladura**
6. Two branches of *Rs* reach the wing-margin. ··· 7
   Three branches of *Rs* reach the wing-margin. ····· 14
7. Rostrum elongate, exceeding one-half the length of the entire body. ····· ····· [**Elephantomyia (Elephantomyodes)**]
   Rostrum short, or of moderate length only, not exceeding in length the remainder of head. 8
8. Wings with R_1 ending before midlength; anterior branch of *Rs* diverging strongly from posterior branch, arising at or close to *r-m*, straight and oblique ····· **Styringomyia**
   Wings with R_1 ending about opposite two-thirds their length; branches of *Rs* subparallel on basal half. ····· 9

9. Wings with R_2 lacking; *Sc* short, Sc_1 ending opposite or before origin of *Rs*; *m-cu* at or before fork of *M*. ····10
Wings with R_2 present; *Sc* usually long, Sc_1 ending beyond origin of *Rs*; *m-cu* beyond fork of *M*. ····11
10. Mid and hind coxae close together, meron small. ···· **Gonomyia** (**Lipophleps,** part)
Mid and hind coxae separated, meron large. ···· [**Atarba** (**Atarbodes**)]
11. Wings with R_2 near tip of R_1; two or three branches of *M* reach the margin. ···· (**Trentepohlia**)···12
Wings with R_2 close to fork of *Rs*; three branches of *M* reach the margin. ····13
12. Wings with cell *1st* M_2 open by atrophy of *m* and two distal sections of M_3; the outer medial veins, M_{1+2} and M_4. ····Sg **Trentepohlia**, s. str.
Wings with cell *1st* M_2 closed; three outer medial veins, M_{1+2}, M_3, and M_4. ···Sg **Mongoma**
13. Wings with cell *2nd* M_2 approximately rectangular at base; hind femora not clubbed. ···· **Teucholabis** (**Teucholabis**)
Wings with cell *2nd* M_2 pointed at base; hind femora distinctly clubbed towards tip. ···· **Gymnastes** (**Paragymnastes**)
14. Wings with cell R_3 short, vein R_3 shorter than the petiole of cell R_3. ····15
Wings with cell R_3 long, vein R_3 longer than the petiole of cell R_3. ····22
15. Wings with R_2 present. ····16
Wings with R_2 lacking. ····19
16. Wings with R_2 at the end of *Rs*, in alignment with the other elements of the cord; *r-m* obliterated by the long fusion of veins R_{4+5} and M_{1+2}. ····**Teucholabis** (**Paratropesa**)
Wings with R_2 its length or more beyond fork of *Rs*; R_{2+3+4} subequal to or longer than R_2; *r-m* distinct. ····17
17. Wings with *Rs* long and straight, exceeding the distal section of M_{1+2}; tuberculate pits on cephalic portion of praescutum; trochanters elongate. ····**Rhabdomastix** (**Sacandaga,** part)
Wings with *Rs* shorter, less than the distal section of M_{1+2}; tuberculate pits removed from cephalic margin of praescutum, nearly in transverse alignment with the pseudosutural fovea; trochanters short. ····(**Erioptera,** part)···18
18. Wings with cell *1st* M_2 closed. ···· Sg **Cheilotrichia**
Wings with cell *1st* M_2 open by atrophy of *m*. ····Sg **Empeda**
19. Wings with *Sc* long, Sc_1 extending to near opposite or beyond midlength of *Rs*; *m-cu* at or beyond fork of *M*; mid and hind coxae separated, meron large. ···· **Rhabdomastix** (**Sacandaga,** part)
Wings with *Sc* short, not extending beyond midlength of *Rs*; if *Sc* is relatively long (Sg *Idiocera*), *m-cu* lies more than its own length before fork of *M*; mid and hind coxae close together, meron small. ····(**Gonomyia,** part)···20
20. Wings with cell R_3 very small, its extent along costal margin subequal to that of cell R_2; anterior arculus lacking. ···· Sg **Lipophleps,** part
Wings with cell R_3 large, its extent along costal margin much greater than that of cell R_2. ····21
21. Wings with *m-cu* about its own length before fork of *M*; anterior arculus present. ···· Sg **Idiocera**
Wings with *m-cu* at or close to fork of *M*; anterior arculus lacking. ··· Sg **Gonomyia,** s. str.
22. Wings with distinct macrotrichia in outer cells. ····23
Wings with the outer cells glabrous. ····27
23. Size very small (wing, 3 mm. or less); wings with *Rs* ending in cell R_3, this cell thus being sessile, without element R_{2+3+4}. ···· **Tasiocera** (**Dasymolophilus**)
Size larger (wing, 4 mm. or more); wings with *Rs* ending in cell R_4, cell *Rs* being petiolate by the presence of a distinct element R_{2+3+4}. ····24
24. Wings with Sc_2 close to tip of Sc_1, the two veins thus being subequal in length or nearly so. ····**Gnophomyia,** part
Wings with Sc_2 far removed from tip of Sc_1, the latter vein long, subequal in length to *Rs*. ···· (**Ormosia**)···25
25. Wings with cell *1st* M_2 open by atrophy of *m*. ····Sg **Oreophila**
Wings with cell *1st* M_2 closed or open by atrophy of the basal section of M_3. ····26
26. Postnotum glabrous; wings with cell *1st* M_2 closed. ····Sg **Scleroprocta**
Postnotum with soft hairs; wings with cell *1st* M_2 closed or open. ····Sg **Ormosia,** s. str.
27. Wings with *Rs* ending in cell R_3, there being no element R_{2+3+4}. ···· **Molophilus**
Wings with *Rs* ending in cell R_4, cell R_3 being petiolate by a distinct element R_{2+3+4}; or R_4 in direct longitudinal alignment with *Rs*. ···28
28. A supernumerary crossvein in cell R_3 of wing; vein *2nd A* strongly bisinuate. ···· **Erioptera** (**Symplecta**)
No supernumerary crossvein in cell R_3; vein *2nd A* straight or simply sinuous. ····29
29. Mid and hind coxae widely separated by a large "pot-bellied" meral region; wings with Sc_1 long, almost as long as, or exceeding one-

half the length of *Rs*.....(**Erioptera,** part)...30

Mid and hind coxae only slightly separated by the small meral region; wings with Sc_1 relatively short, not exceeding one-third the length of *Rs*. 36

30. Antennae with very long verticils; wing with cell *1st* M_2 closed; *m-cu* about two-thirds to fully its own length beyond fork of *M*.....
..... Sg **Hoploerioptera**

Antennal verticils not conspicuously lengthened; wings with *m-cu* before or at fork of *M*. 31

31. Wings with R_{2+3} perpendicular at the end of *Rs*, bent at a right angle, at the bend with R_2 directed basad, thence angularly bent to joint R_1; R_4 and R_5 at the end of *Rs*, and R_4 in direct longitudinal alignment with *Rs*; basal section of R_5 in direct transverse alignment with R_{2+3}; cell *1st* M_2 open by atrophy of *m*; vein *2nd A* sinuous. .....Sg **Tasiocerodes**

Wings with R_{2+3} out of perpendicular at the end of *Rs*; R_4 not in direct longitudinal alignment with *Rs*; basal section of R_5 making an acute angle with R_{2+3+4}. 32

32. Wings with vein *2nd A* arcuated; cell *1st* M_2 open by atrophy of *m*.....33

Wings with vein *2nd A* straight or essentially so; cell *1st* M_2 closed or open; anal veins divergent, cell *1st A* being widest at margin. 34

33. Basal three or four segments of antennal flagellum united into a short, truncate-conical fusion segment, antennae thus with 12 or 13 segments; wings with cord beyond midlength; the distal fourth of vein *2nd A* being deflected slightly cephalad and not strongly constricting cell *1st A*. .....Sg **Meterioptera**

Antennae normal, with 16 segments; wings with cord almost at midlength; the distal portion of vein *2nd A* being deflected strongly cephalad so cell *1st A* at midlength is usually as wide as, or wider than it is at margin. .....
..... Sg **Erioptera,** s. str.

34. Wings with a more or less complete spur from the angulated basal section of vein M_3 jutting basad, into cell *1st* M_2, sometimes completely dividing the cell; cell *1st* M_2 closed.
..... Sg **Hoplolabis**

Wings without such a spur. 35

35. Wings with cell *1st* M_2 open by atrophy of *m*; ♂ hypopygium not inverted, with aedeagus simple. .....Sg **Arctoconopa**

Wings with cell *1st* M_2 closed (*Ilisia*) or open; ♂ hypopygium inverted (*Ilisia*) or not, with aedeagus bifid. .....Sg **Psiloconopa**

36. Wings with *Rs* in alignment with R_{2+3+4}; R_{1+2} short, subequal to R_2 and less than one-half R_{2+3+4}; *Sc* short, Sc_1 ending opposite fork of *Rs* and far before R_2, Sc_1 and Sc_2 subequal in length; *m-cu* at or close to fork of *M*; ♂ hypopygium with interbasal structures conspicuously developed as blackened spines. .....
..... **Lipsothrix**

Wings with *Rs* in approximate alignment with R_5; R_{1+2} long, more than three times R_2 and exceeding R_{2+3+4}; *Sc* long, Sc_1 ending opposite or shortly before R_2, at or beyond midlength of R_{2+3+4}, Sc_1 much longer than Sc_2; *m-cu* some distance beyond fork of *M*; ♂ hypopygium without evident interbases. .....
..... **Gnophomyia,** part

Genus **CONOSIA** Wulp, 1880

Conosia Wulp; *TE, 23:159; O. S.: BEZ, 31:206-7 (1887); Skuse: PLSN, (2)4:835-7 (1890); Kert.: KPD, 1:302 (1903); Brun.: FBI, 439, 496-7 (1912); RIM, 17:248 (1920); Wu: CIS, 5:48-9 (1940).

Type: *Limnobia irrorata* Wied.

C. irrorata (Wied., 1828): *Aussereur. Zweifl. Ins., 1:574 [*Limnobia*], t: Java; Wulp: *TE, 23:159-61, X:5-7 (1880); O. S.: BEZ, 31:206-7 [*Limnobia*] (1887); Skuse: PLSN, (2)4:837-8, XXIV:60 (mouth parts); 61 (a); 62 (h) (1890); Kert.: KPD, 1:302 (1903); Edw.: AM, (8)8:64 (1911); AM, (8)18:253 (1916); Brun.: RIM, 6:283 (1911); FBI, 497-9, f. 43 (lateral view of head & thorax); X:5 (w) (1912); RIM, 17:248 (1920); Alex.: CE, 45:293, III:13 (w) (1913); Proc. Hawai. ent. Soc., 5:259 (1923); PJS, 24:594 (1924); PJS, 33:305, II:16 (w) (1927); AH, 180 (1931); PLSN, 61:329 (1936); PJS, 61:114 (1936); NEC, 4:87 (1937); TSES, 3:82 (1953); Mushi, 27:29 (1954); Ried.: AN, 82A:113 (1917); Bezzi: PJS, (D) 12: 114 (1917); Esaki: IIJ, 204, f. 398 (♀) (1932); IIJ, ed. 2, 1525, f. 4376 (♀) (1950); Wu: CIS, 5:48-9 (1940); Shir.: CI, 644 (1954).

substituta (Walk., 1848): *List Dipt. Brit. Mus., 1:39 [*Limnobia*], t: China; Coq.: PUNM, 21:303-4 (1898); Mats.: KB, 2:63-4 (1915).

crux (Dol., 1857): *Nat. Tijd. Ned. Ind., 14:388, IV:3 [*Limnophila*].

ssp. **irrorata** (Wied., 1828)

Dist: JAPAN (Hokkaido; Honshu; Shikoku; Kyushu); KOREA; FORMOSA; CHINA; S. ASIA; NEW GUINEA; E. AUSTRALIA; PALESTINE; AFRICA.

Nom. Jap.: *Sedaka-gagambo* (Esaki); *Mitsuboshi-gagambo-damashi* (Mats.).

Genus **CLADURA** O. S., 1860

Cladura O. S.: *PAP, 1859:229; MD, 4:46, 187-8 (1869); BEZ, 31:205-6 (1887); Coq.: PUNM, 37: 524 (1910); Brun.: RIM, 6:283 (1911); FBI, 439, 499-500 (1912); RIM, 15:319 (1918); RIM, 17:

248 (1920); ALEX.: PUNM, 44:492 (1913); MCAS, 25:901, 903–4 (1919); PUNM, 58:416 (1920) (with MCATEE); MCAS, 38:947–8 (1920); FG, 49 (1934) [k]; BCSS, 64:424, 426 (1942) [k]; PJS, 83:293–4 (1954); PJS, 86:304 (1958).

Type: *Cladura flavoferruginea* O. S.

Subgenus **CLADURA,** s. str.

C. (C.) alpicola ALEX., 1929: PJS, 40:341–2, I:17 (w); III:38 (h) (No Sg), t: Yarigatake, Japanese Alps; Tsubakuro, Japanese Alps (♂); AESA, 40:360 (No Sg) (1947) [n]; BBES, 50:18 (1955).

ssp. **alpicola** ALEX., 1929

Dist: JAPAN (Honshu).

ssp. **setuliloba** ALEX., 1947: AESA, 40:360 (No Sg) (*alpicola*, ssp.), t: Mt. Myotaka (♂).

Dist: JAPAN (Honshu).

C. (C.) autumna ALEX., 1920: IIM, 8:137–8 (No Sg), t: Meguro, Tokyo (♂♀); PJS, 31:370, II:9–10 (h) (No Sg) (1926); PJS, 82:71 (1953); PJS, 86:305, V:31 (h) (1958).

Dist: JAPAN (Honshu).

C. (C.) babai ALEX., 1955: BBES, 50:18–9, t: Kurokawa, Echigo; Mt. Chokai, Uzen, alt. 600 m.; Morioka, Rikuchiu (♂); PJS, 86:305–6, V:32 (h) (1958).

Dist: JAPAN (Honshu).

C. (C.) bicornuta ALEX., 1955: AESA, 48:373, t: Shirahone-onsen, Shinano, alt. 1,500 m.; Mt. Norikura, near Reisen-goya, Shinano, alt. 2,400 m. (♂♀); PJS, 86:306–7, V:34 (h) (1958).

Dist: JAPAN (Honshu).

C. (C.) bidens ALEX., 1926: PJS, 31:369–70, II:6, 8 (h) (No Sg), t: Maruyama, near Sapporo, Ishikari (♂♀); PJS, 86:306, V:33 (h) (1958).

Dist: JAPAN (Hokkaido; Honshu).

C. (C.) brevifila ALEX., 1958: PJS, 86:307–8, V:30 (w); 35 (h), t: Mt. Tanigawa (as Tanigawad), Kotsuke, alt. 800 m. (♂♀).

Dist: JAPAN (Honshu).

C. (C.) daimio ALEX., 1947: AESA, 40:359–60 (No Sg), t: Morioka (♂♀); BBES, 50:19 (1955); PJS, 86:308, V:36 (h) (1958).

Dist: JAPAN (Honshu).

C. (C.) decem-notata ALEX., 1924: AESA, 17:436–7 (No Sg), t: Aburayama, Chikuzen; Mt. Kirishima, on boundary between Osumi and Hiuga, alt. 3,250 ft. (♀); AESA, 40:361 (No Sg) (1947) [n]; PJS, 82:69, II:27 (h) (1953).

Dist: JAPAN (Shikoku; Kyushu).

C. (C.) fuscivena ALEX., 1955: AESA, 48:372–3, t: Sugadaira, Shinano (♀).

Dist: JAPAN (Honshu).

C. (C.) hakonensis ALEX., 1947: AESA, 40:362–3 (No Sg), t: Gora, Hakone District (♀); PJS, 83:294 [s. str.] (1954); PJS, 86:308–9, V:37 (h) (1958).

ssp. **hakonensis** ALEX., 1947

Dist: JAPAN (Honshu).

ssp. **porrecta** ALEX., 1954: PJS, 83:294–5, IV:39 (h) (*hakonensis*, ssp.), t: Omogo Valley, Iyo; Mominoki, Mt. Saragamine, alt. 700 to 800 m.; Mt. Takanawa, alt. 900 m. (♂♀).

Dist: JAPAN (Shikoku).

C. (C.) itoi ALEX., 1955: BBES, 50:19–20, t: Sigakôgen, Shinano, alt. 1,600 m. (♂); PJS, 85:366, II:19 (h) (1957).

Dist: JAPAN (Honshu).

C. (C.) japonica (ALEX., 1918): AESA, 11:448 [*Crypteria*], t: No specific data, but possibly Kioto (♀); EM, 3:125 [*Crypteria*] (1919); IIM, 8:137–8 (No Sg) (1920) [n]; PJS, 86:309 (1958) [n].

Dist: JAPAN (Honshu).

C. (C.) machidella ALEX., 1934: PJS, 55:50–1, I:19 (w), t: Mt. Hiei, Kyoto (♀); PJS, 83:295–6, IV:40 (h) (1954) [♂, allotype: Omogo Valley, Iyo]; PJS, 86:309 (1958) [n].

Dist: JAPAN (Honshu; Shikoku).

C. (C.) megacauda ALEX., 1926: PJS, 31:370–1, I:7 (w); II:4–5 (h) (No Sg), t: Sapporo, Ishikari (♂); AESA, 40:360 (No Sg) (1947) [n]; BBES, 50:20–1 (1955).

Dist: JAPAN (Hokkaido; Honshu).

C. (C.) microphallus ALEX., 1954: PJS, 83:296–7, IV:34 (w); 41 (h), t: Omogo Valley, Iyo; Mominoki, Mt. Saragamine, alt. 700 to 800 m.; Mt. Takanawa, alt. 950 m. (♂).

Dist: JAPAN (Shikoku).

C. (C.) monacantha ALEX., 1947: AESA, 40:363–4 (No Sg), t: Tottori Pref. (♂); PJS, 86:310, V:38 (h) (1958).

ssp. **monacantha** ALEX., 1947

Dist: JAPAN (Honshu).

ssp. **fimbriata** ALEX., 1947: AESA, 40:364 (No Sg) (*monacantha*, ssp.), t: Gora, Hakone District (♂); PJS, 86:310 (*monacantha*, ssp.) (1958) [n].

Dist : JAPAN (Honshu).

C. (C.) nipponensis ALEX., 1920: IIM, 8:136 (No Sg), t: Tokyo (♂♀); PJS, 31:370, II:7 (h) (No Sg) (1926); PJS, 86:310–1, V:39 (h) (1958).

Dist: JAPAN (Honshu).

C. (C.) recurvalis ALEX., 1957: PJS, 85:368–9, II:21 (h), t: Kurokawa, Echigo (♂).

Dist: JAPAN (Honshu).

C. (C.) sawanoi ALEX., 1957: PJS, 85:366–8, II:20 (h), t: Mt. Daisen, Hoki, alt. 800 m. (♂♀).

Dist: JAPAN (Honshu).

C. (C.) serrimargo ALEX., 1953: PJS, 82:70–1, II:21 (w); 25 (h), t: Sugitate, Iyo (♂).

Dist: JAPAN (Shikoku).

C. (C.) shirahatai ALEX., 1955: BBES, 50:21–2, t: Sakata, Uzen (♂); PJS, 85:369–70, II:22 (h) (1957).

Dist: JAPAN (Honshu).

C. (C.) shomio Alex., 1954: PJS, 83:297-9, IV:35 (w); 42 (h), t: Mt. Saragamine, Iyo, alt. 800 to 900 m. (♂).
Dist: JAPAN (Shikoku).

C. (C.) supernumeraria Alex., 1957: PJS, 85:364 6, II:17 (w); 18 (h), t: Kurokawa, Echigo (♂♀).
Dist: JAPAN (Honshu).

C. (C.) telephallus Alex., 1955: AESA, 48:373 4, t: Oze, Hatomati Toge, Kotsuke (♂); PJS, 86: 311, V:40 (h) (1958).
Dist: JAPAN (Honshu).

C. (C.) tetraspila Alex., 1947: AESA, 40:361-2 (No Sg), t: Gora, Hakone District (♂♀); PJS, 83:299, IV:43 (h) (1954).
Dist: JAPAN (Honshu; Shikoku).

C. (C.) trifilosa Alex., 1957: PJS, 85:370-1, II:15 (h), t: Kurokawa, Echigo (♂♀).
Dist: JAPAN (Honshu).

Genus **CHIONEA** Dalm., 1816

Chionea Dalm.: *K. Vet. Akad. Handl., 1:102 [according to Coq., as 104]; Macq.: HNI, 1:72, 148 (1834); Meig.: SB, 7:37 (1838); Rond.: PDI, 1: 189 (*Chionla*!) (1856); Schin.: FA, 2:xxv, 573-4 (1864); O. S.: MD, 4:46, 136, 168-9 (1869); BEZ, 31:196 (1887); Kert.: KPD, 1:297 (1903); Coq.: PUNM, 37:522 (1910); Boldyrev: Rev. russe d'Ent., 13:308-22 (1913); Alex.: PUNM, 44:492 (1913); CE. 49:202 & 204 (1917): MCAS, 25:901, 902-3 (1919); MCAS, 38:909, 950-1 (1920) [L]; FG, 48, 52 (1934); BCSS, 64:424, 428 (1942); Pierre: FF, 8:91, 92-3 (1924); End.: TM, 19 (1936).
Type: *Chionea araneoides* Dalm.

Sphaeconophilus Becker, 1912: *Ann. Soc. ent. Belg., 56:142.
Type: *Sphaeconophilus belgicus* Becker

Niphadobata End., 1936: TM, 19.
Type: *Chionea lutescens* Lundst.

C. gracilistyla Alex., 1936: PJS, 60:187-8, II:32 (h), t: Chiosen, Honshiu, Japan; Tukuringa Mountains, Amur, Eastern Siberia (♂).
Dist: JAPAN (Honshu); E. SIBERIA.

C. nipponica Alex., 1932: PJS, 49:127-8, III:42 (h), t: Mt. Tsurugi, Toyama, Japanese Alps, alt. 8,775 ft.; Seki, Niigata, alt. 2,925 ft. (♂♀); Tok.: IIJ, ed. 2, 1528, f. 4384 (♂) (1950); Shir.: CI, 644, f. 1203 (♂) (1954).
?*araneoides* Mats., 1915: KB, 2:63, II:15 (♀); 6000, p. 391, f. 243 (♀) (1931) [nec Dalm., 1816].
Dist: JAPAN (Hokkaido; Honshu).
Nom. Jap.: *Nippon-yuki-gagambo* (Tok.); *Kumogata-gagambo* (Mats.).

Genus **NEOLIMNOPHILA** Alex., 1920

Neolimnophila Alex.: *Proc. Calif. Ac. Sci., (4)10: 37-8 [*Limnophila*]; PJS, 24:594 (1924); FG, 49 (1934); BCSS, 64:424, 429 (1942); Wu: CIS, 5:58 (1940); Coe: HIBI, 45, 48, f. 18a (lower parts of pleurae, with mid & hind coxae) (1950).
Type: *Limnophila ultima* O. S.

N. ultima (O. S., 1860): *PAP, 1859:238, IV:26 [*Limnophila*]; MD, 4:202, 222-3, IV:24 (h) [*Limnophila*] (1869); Alex.: MCAS, 25:917, XXXVIII: 127 (w) [*Limnophila*] (1919); PUNM, 58:425 [*Limnophila*] (1920) (with McAtee); PJS, 24:594 (var.) (1924); Konowia, 9:105 (1930) [n]; BCSS, 64:430, f. 47B (w) (1942).
?*japonica* (Mats., 1915): KB, 2:64, II:16 (♀, as *Trichocera japonica* Mats.) [*Limnobia*], t: Japan (♀) [praeocc. by Alex., 1913].
Dist: ?JAPAN; SAKHALIN; E. SIBERIA; N. AMERICA.
Nom. Jap.: *Usuiro-gagambo-damashi* (Mats.).

Genus **GNOPHOMYIA** O. S., 1860

Gnophomyia O. S.: *PAP, 1859:223; MD, 4:47, 172-4 (1869); MD, add., ix (1873); BEZ, 31:198-9 (1887); Skuse: PLSN, (2)4:823 (1890); Kert.: KPD, 1: 299 (1903); Coq.: PUNM, 37:547 (1910); Brun.: FBI, 439, 487-8 (1912); RIM, 17:246 (1920); Alex.: PUNM, 44:492, 521-2 (1913); MCAS, 25: 902, 909-10 (1919); PUNM, 58:416, 422 (1920) (with McAtee); MCAS, 38:909, 910, 934-5 (1920) [L; P]; AM, (9)16:70 (1925); FG, 51 (1934); BCSS, 64:425, 430 (1942); Pierre: FF, 8:92, 112 (1924); End.: TM, 21 (1936); Wu: CIS, 5:53 (1940); Coe: HIBI, 46, 49 (1950).
Type: *Gnophomyia tristissima* O. S.

Subgenus **GNOPHOMYIA,** s. str.

G. (G.) acheron Alex., 1950: AESA, 43:433-4, t: Funakosi, Iwate, alt. 200 m. (♂♀).
Dist: JAPAN (Honshu).

G. (G.) laterospinosa Alex., 1928: PJS, 36:473-4, I:13 (w); II:12 (h) (No Sg), t: Tatusawa, near Inawasiro, Fukushima, alt. 2,000 ft. (♂).
Dist: JAPAN (Honshu).

G. (G.) nycteris Alex., 1924: AESA, 17:68 (No Sg), t: Mt. Minomo, Settsu (♀); AESA, 43:434 (1950).
Dist: JAPAN (Honshu).

G. (G.) tristis Alex., 1924: PJS, 24:588 (No Sg), t: Toyohara, Saghalien (♀); PJS, 44:340 (No Sg) (1931).
Dist: JAPAN (Honshu); SAKHALIN.

Genus **GONOMYIA** Merg., 1818

Gonomyia Merg.: in Meig., *SB, 1:146 [116]; O. S.: *PAP, 1859:229 (1860); MD, 4:47, 176-80 (*Goniomyia*!) (1869); BEZ, 31:200-2 (1887); Schin.: FA, 2:xxvii, 542-5 (1864); Skuse: PLSN, (2)4:825-6 (1890); Kert.: KPD, 1:299-301 (1903); Coq.: PUNM, 37:547 (1910); Brun.: FBI, 439, 468-71 (1912); RIM, 15:311 (1918); RIM, 17:240-1 (1920); Bergr.: AM, (8)11:581-2 (1913); Alex.: PUNM,

44:492, 503-4 (1913) [k]; MCAS, 25:901, 904-5 (1919); PUNM, 58:416, 420-1 (1920) [k] (with McAtee); MCAS, 38:910, 938 (1920) [L; P]; PJS, 48:615-7 (1932) [k]; FG, 49, 50, 51 (1934) [k]; PJS, 62:177-8 (1937) [k]; PJS, 66:126-7 (1938); BCSS, 64:425, 433-4, 438-9, (1942) [k]; Pierre: FF, 8:92, 107-8, 142, f. k, k^1 (L); k^2 (P) (1924); Edw.: JMM, 14:103-4 (1928); End.: TM, 20, f. 32 (w) (1936); Lacks.: ANMW, 50:49-50, 56-9 (1940) [k]; Wu: CIS, 5:53-6 (1940); Coe: HIBI, 46, 49-51, f. 18c (lower parts of pleurae, with mid & hind coxae); 21a (wing-base) (1950) [k].

Type: *Limnobia tenella* Meig. (as *tricolor* Merg.).

Taphrosia Rond., 1856: PDI, 1:182; O. S.: MD, 4:12 (*Taphrosa*!) (1869); BEZ, 31:232 (1887); Coq.: PUNM, 37:612 (1910).

Type: *Limnobia tenella* Meig. (as Hoffm.).

Subgenus **IDIOCERA** Dale, 1842

Idiocera Dale: AM, 8:431, 433 [*Limnobia*]; Wu: CIS, 5:55-6 [*Gonomyia*] (1940); Alex.: BCSS, 64:434, 436 [*Gonomyia*] (1942); Coe: HIBI, 46, 49-50 [*Gonomyia*] (1950).

Type: *Limnobia* (*I.*?) *sex-guttata* Dale

Ptilostena Bergr., 1913: AM, (8)11:575-6; Edw.: JMM, 14:103-4, 107 [*Gonomyia*] (1928); Alex.: PJS, 48:617 [*Gonomyia*] (1932); FG, 50 [*Gonomyia*] (1934); Lacks.: ANMW, 50:50, 51 [*Gonomyia*] (1940).

Type: *Ptilostena recurvinervis* Bergr.

G. (I.) arete Alex., 1958: PJS, 86:311-3, VI:41 (w); 47 (h), t: Kurokawa, Echigo (♂).

Dist: JAPAN (Honshu).

G. (I.) kuwayamai Alex., 1926: PJS, 31:368-9, I:5 (w) (Sg *Ptilostena*), t: Maruyama, near Sapporo, Ishikari (♂♀).

Dist: JAPAN (Hokkaido).

G. (I.) longipennis Alex., 1935: PJS, 57:219-20, I:19 (w) (Sg *Ptilostena*), t: Iriomote Islands (♀).

Dist: JAPAN (Loochoo Is.: Iriomote I.).

G. (I.) nigrilobata Alex., 1957: PJS, 85:372-3, III:23 (w); 24 (h), t: Kurokawa, Echigo (♂).

Dist: JAPAN (Honshu).

G. (I.) pallens Alex., 1928: PJS, 36:474-5, I:14 (w); II:13 (h) (Sg *Ptilostena*), t: Sakunami, near Sendai, Miyagi (♂); PJS, 76:161 (1938) [n].

Dist: JAPAN (Honshu).

G. (I.) serrulifera Alex., 1957: PJS, 85:373-4, III:25 (w); 29 (h), t: Kurokawa, Echigo (♂).

Dist: JAPAN (Honshu).

G. (I.) shantungensis Alex., 1930: PJS, 42:77-8, II:32 (h) (Sg *Ptilostena*), t: Lau Stan, east of Tsingtao, Shantung, Eastern China (♂); PJS, 50:154 (Sg *Ptilostena*) (1933); PJS, 82:171 (1953); Wu: CIS, 5:56 (1940).

Dist: JAPAN (Shikoku); E. CHINA.

G. (I.) subpruinosa Alex., 1924: PJS, 24:588-90 (Sg *Ptilostena*), t: Jozankei, Hokkaido; Koiwai Farm, near Morioka, Northern Honshiu (♂♀); PJS, 86:313, VI:48 (h) (1958); Esaki: IIJ, 209, f. 408 (♂) (No Sg) (1932); IIJ, ed. 2, 1528, f. 4383 (♂) (No Sg) (1950).

Dist: JAPAN (Hokkaido; Honshu).

Nom. Jap.: *Hosoba-hime-gagambo* (Esaki).

G. (I.) teranishii Alex., 1921: AESA, 14:118-9 (Sg *Ptilostena*), t: Koiwai Farm, near Morioka (♀); PJS, 57:219-20 (Sg *Ptilostena*) (1935) [n]; PJS, 63:394 [*Idiocera* (*Idiocera*)] (1937); PJS, 86: 313-4, VI:49 (h) (1958); Wu: CIS, 5:56 (1940).

Dist: JAPAN (Honshu); CHINA.

Subgenus **GONOMYIA,** s. str.

G. (G.) bibarbata Alex., 1935: PJS, 57:220, I:20 (w); III:36 (h), t: Iriomote Island (♂).

Dist: JAPAN (Loochoo Is.: Iriomote I.).

G. (G.) gilvipennis Alex., 1928: PJS, 36:476-7, I:16 (w); II:14 (h), t: Tatusawa, near Inawasiro, Fukushima, alt. 2,000 ft. (♂♀); PJS, 59:249 (1936) [n].

Dist: JAPAN (Honshu).

G. (G.) gracilistyla Alex., 1925: AM, (9)15:70-1 (*gracilistylus*!), t: Mt. Hakone, Sagami, alt. 2,300 ft. (♂); PJS, 58:250 (Sg *Lipophleps*) (*gracilistylus*!) (1935) [n]; PJS, 85:374-5, III:26 (w); 30 (h) (*gracilistylus*!) (1957).

Dist: JAPAN (Honshu; Kyushu).

G. (G.) horribilis Alex., 1941: PJS, 76:60-2, I:22 (w); IV:44 (h), t: Kamikochi, alt. 5,000 ft. (♂♀).

Dist: JAPAN (Honshu).

G. (G.) kurokawae Alex., 1957: PJS, 85:375-6, III:27 (w); 31 (h), t: Kurokawa, Echigo (♂).

Dist: JAPAN (Honshu).

G. (G.) luteipleura Alex., 1936: PJS, 59:248-9, I:20 (w), t: Mt. Daisen, Hoki (♀).

Dist: JAPAN (Honshu).

G. (G.) nansei Alex., 1930: PJS, 43:524-5, I:15 (w); III:40 (h), t: Hassensan, Formosa, alt. 2,500 to 5,600 ft. (Holo-: 5,600; allotype: 3,600) (♂♀); PJS, 82:302 (1954).

Dist: JAPAN (Shikoku); FORMOSA.

G. (G.) necopina Alex., 1957: PJS, 85:376-7, III: 28 (w); 32 (h), t: Kurokawa, Echigo (♂♀).

Dist: JAPAN (Honshu).

G. (G.) omogoensis Alex., 1954: PJS, 83:299-300, IV:36 (w); 44 (h), t: Omogo Valley, Iyo, alt. 800 m. (♂♀).

Dist: JAPAN (Shikoku).

G. (G.) superba Alex., 1913: CE, 45:285-6, III:14 (w); X:1-2 (h), t: Tokio; Nishigahara (♂♀); PJS, 24:588 (1924); PUNM, 68(4):13 [as sp. near *superba*] (1925); PJS, 67:161 (var.) (1938); Mushi, 27:29 [as near *superba*] (1954).

Dist: JAPAN (Hokkaido; Honshu); N. KOREA; ?E. SIBERIA; ?N. CHINA.

Subgenus **LIPOPHLEPS** Bergr., 1915

Lipophleps Bergr.: Psyche, 22:55 [nom. nov. for *Leiponeura*]; Edw.: JMM, 14:103, 104–5 [*Gonomyia*] (1928); Alex.: PJS, 48:615–7 [*Gonomyia*] (1932); FG, 49, 50 [*Gonomyia*] (1934); BCSS, 64:433, 434 [*Gonomyia*] (1942); Wu: CIS, 5:54–5 [*Gonomyia*] (1940); Coe: HIBI, 46, 50 [*Gonomyia*] (1950).

Type: *Gonomyia skusei* Alex.

Leiponeura Skuse, 1890: PLSN, (2)4:795–6; Bergr.: AM, (8)11:581–2 (*Liponeura*!) (1913); Alex.: PUNM, 44:503–4 [*Gonomyia*] (1913); MCAS, 25: 890, 905 [*Gonomyia*] (1919); PUNM, 58:392, 420–1 [*Gonomyia*] (1920) (with McAtee); MCAS, 38: 909, 939 [*Gonomyia*] (1920) [L; P] [praeocc. by Loew, 1844].

Type: *Gonomyia skusei* Alex. (as *gracilis*, sp. nov.).

G. (L.) flavocostalis Alex., 1924: PJS, 24 : 590–1 (*flavo costalis*!), t: Jozankei; Kutchan; Shikaripetsu (♂♀); PJS, 46:33 (1933) [n]; PJS, 66:330 (1938) [n].

Dist: JAPAN (Hokkaido).

G. (L.) incompleta Brun., 1912: FBI, 470, 471–2, IX:5 (w); XI:19 (h) (No Sg), t: Calcutta [according to Brun., 1920] (♂♀); RIM, 17:240 (No Sg) (1920); Bergr.: AM, (8)11:581 [*Liponeura*!] (1913); Edw.: JMM, 14:104, 105 (1928); Alex.: PJS, 46:29–30 (1930); PJS, 48:616 (1932); PJS, 61:114 (1936); PJS, 76:60 (1941) [n]; Wu: CIS, 5:54 (1940).

insulensis Alex., 1913: CE, 45:286–7, III:12 (w) (Sg *Leiponeura*), t: Tokio (♀).

Dist: JAPAN (Honshu); CHINA; S. ASIA.

G. (L.) quadrifila Alex., 1930: PJS, 42:530–1, I: 18 (w); II:31 (h), t: Yasakagawa, Oita (♂); PJS, 82:302 (1954).

Dist: JAPAN (Shikoku; Kyushu).

G. (L.) sauteri Alex., 1930: PJS, 43:525–6, I:16 (w); III:41 (h), t: Daitotei. Formosa (♂); PJS, 63:392–3 (1937); PJS, 82:302 (1954); Wu: CIS, 5:55 (1940).

?*gracilis* (Ried., 1917): AN, 82A:112 [*Liponeura*!] [nec Skuse, 1890].

Dist: JAPAN (Shikoku); FORMOSA; CHINA.

Genus **TEUCHOLABIS** O. S., 1860

Teucholabis O. S.: *PAP, 1859:222; MD, 4:46, 129–32 (1869); BEZ, 26:188 (1882); BEZ, 31:188 (1887); Skuse: PLSN, (2)4:798 (1890); Coq.: PUNM, 37: 613 (1910); Brun.: FBI, 415, 427–8 (1912); RIM, 17:232–4 (1920); Alex.: MCAS, 25:897, 901 (1919); PUNM, 58:414, 416 (1920) (with McAtee); MCAS, 38:909, 910, 945–6 (1920) [L; P]; PJS, 48:43–4 (1932); FG, 49, 50 (1934) [k]; BCSS, 64:425, 431–2 (1942); Wu: CIS, 5:60–1 (1940).

Type: *Teucholabis complexa* O. S.

Subgenus **TEUCHOLABIS,** s. str.

T. (T.) iriomotensis Alex., 1935: PJS, 57:218–9, I:18 (w), t: Iriomote Island (♂♀).

Dist: JAPAN (Loochoo Is.: Iriomote I.).

T. (T.) yezoensis Alex., 1924: PJS, 24:593–4 (No Sg), t: Shikaripetsu (♂♀); PJS, 57:219 (1935) [n].

Dist: JAPAN (Hokkaido).

Subgenus **PARATROPESA** Schin., 1866

Paratropesa Schin.: VZBG, 16:932–3; O. S.: MD, 4: 132, 333 (1869); BEZ, 31:189–90 (1887); Alex.: AESA, 12 : 333 (*Paratropeza*!) (1919); FG, 50 [*Teucholabis*] (1934).

Type: *Paratropesa singularis* Schin.

T. (P.) esakii (Alex., 1924): PJS, 24:591–3 [*Paratropesa*], t: Maruyama; Jozankei; Abashiri (♂♀); AESA, 48:374 (1955) [n].

Dist: JAPAN (Hokkaido).

T. (P.) inouei Alex., 1955: AESA, 48:374, t: Mt. Takao, Musashi (♂).

Dist: JAPAN (Honshu).

Genus **GYMNASTES** Brun., 1911

Gymnastes Brun.: RIM, 6:281; FBI, 415, 432–3 (1912); RIM, 15:307 (1918); RIM, 17:234 (1920); Edw.: AM, (8)17:359–60 (1916); Alex.: PLSN, 47:583 (1922); PJS, 48:42 (1932); Wu: CIS, 5:56 (1940).

Type: *Teucholabis cyanea* Edw. (as *violaceus*, sp. nov.).

Subgenus **PARAGYMNASTES** Alex., 1922

Paragymnastes Alex.: PLSN, 47:583; PJS, 48:42 [*Gymnastes*] (1932).

Type: *Limnobia fascipennis* Thomson

G. (P.) flavitibia (Alex., 1919): AESA, 12:333–4 [*Paratropeza*!], t: Chichibu, Saitama (♀); PLSN, 47:583 (No Sg) (1922); LSJ, 19:115 [s. str.] (1940); TSES, 3:82 (1953); Esaki: IIJ, 206, f. 401 (♀) (No Sg) (1932); IIJ, ed. 2, 1526, f. 4377 (♀) (No Sg) (1950); Shir.: CI, 644 (No Sg) (1954).

ssp. **flavitibia** (Alex., 1919)

Dist: JAPAN (Honshu; Shikoku; Kyushu).

Nom. Jap.: *Misuji-gagambo* (Esaki).

Genus **TRENTEPOHLIA** Big., 1854

Trentepohlia Big.: *ASEF, (3)2:456, 473; Bergr.: Ent. Tids., 8:136–7 (1888); AM, (8)11:582 (1913); Skuse: PLSN, (2)4:831–4 (1890); Edw.: AM, (8)8: 63–4 (1911); JMM, 14:108, 114 (1928); End.: ZJ, 32:61 (1912); Brun.: RIM, 15:315 (1918); RIM, 17:242–3 (1920); Alex.: MCAS, 38:943 (1920); PJS, 33:302 (1927) [k]; PJS, 43:297–8 (1930) [k]; PJS, 53:441–4 (1934) [k]; FG, 49 (1934); *AM, (11)1:355 (1938) [k]; Wu: CIS, 5:61–2 (1940).

Type: *Limnobia trentepohlii* Wied.

Mongomioides Brun., 1911: RIM, 6:296; FBI, 439, 478, 481–2 (1912).

Type: *Limnobia trentepohlii* Wied.

Subgenus **TRENTEPOHLIA,** s. str.

T. (T.) septemtrionalis Alex., 1921: AESA, 14: 119–20, t: Nakano (♀).
Dist: JAPAN (Honshu).

Subgenus **MONGOMA** Westw., 1881

Mongoma Westw.: TES, 1881:364; O. S.: BEZ, 26: 89–91 (1882); BEZ, 31:203–4 (1887); Brun.: RIM, 6:290, 292 (1911); FBI, 439, 476–9 (1912); RIM, 15:311 (1918); RIM, 17:241–2 (1920); End.: ZJ, 32:59–60 (1912); Bergr.: AM, (8)11:582 (1913); Alex.: PUNM, 44:492, 499–500 (1913); MCAS, 38:944 [*Trentepohlia*] (1920); PJS, 33:302 [*Trentepohlia*] (1927); PJS, 43:297–8 [*Trentepohlia*] (1930); PJS, 46:471 [*Trentepohlia*] (1931); PJS, 53:442–4 [*Trentepohlia*] (1934); Edw.: JMM, 14: 110–1 [*Trentepohlia*] (1928); Wu: CIS, 5:61 [*Trentepohlia*] (1940).
Type: *Mongoma fragillima* Westw.

T. (M.) subpennipes Alex., 1957: PJS, 85:371–2, II:16 (w), t: Yoshigahira, Mt. Sumon, Echigo; Kurokawa, Echigo; Mt. Donden, Sado Island, Sado; Aridagun, Kii (♂).
pennipes Alex., 1931: AH, 180 (part) [nec O. S., 1887].
Dist: JAPAN (Honshu).

Genus **LIPSOTHRIX** Loew, 1873

Lipsothrix Loew: *Beschr. Eur. Dipt., 3:69; O. S.: BEZ, 31:205 (1887); Kert.: KPD, 1:301–2 (1903); Pierre: FF, 8:92, 110 (1924); Alex.: PJS, 50:152 (1933); FG, 51 (1934); BCSS, 64:425, 431 (1942); End.: TM, 21, f. 33 (w) (1936); Lacks.: ANMW, 50:63–4 (1940); Coe: HIBI, 46, 48–9 (1950).
Type: *Lipsothrix nobilis* Loew
Electrolabis Alex., 1931: *Bernsteinforschungen, Heft 2:58–9.
Type: *Electrolabis extincta* Alex.

L. apicifusca Alex., 1957: PJS, 85:377–8, IV:33 (w); 39 (h), t: Kurokawa, Echigo (♂).
Dist: JAPAN (Honshu).

L. babai Alex., 1958: PJS, 86:314–5, VI:44 (w); 50 (h), t: Kurokawa, Echigo; Mt. Amakazari, Echigo, alt. 1,000 m. (♂♀).
Dist: JAPAN (Honshu).

L. leucopeza Alex., 1953: PJS, 82:170, III:22 (w) t: Totidani, near Yanase, Tosa, alt. 400 m. (♂♀).
Dist: JAPAN (Shikoku).

L. tokunagai Alex., 1933: PJS, 50:152, I:18 (w); III:44 (h), t: Mt. Daisen, Tottori (♂); PJS, 85: 378 (1957) [n]; PJS, 86:315 (1958) [n].
Dist: JAPAN (Honshu).

L. yakushimae Alex., 1930: PJS, 42:75–6, I:13 (w), t: Kosugidani, Yakushima, alt. 2,500 ft. (♀).
Dist: JAPAN (Kyushu: Yaku I.).

L. yamamotoana Alex., 1950: AESA, 43:433, t: Funakosi, Iwate, alt. 200 m. (♂).
ssp. **yamamotoana** Alex., 1950
Dist: JAPAN (Honshu).
ssp. **omogoensis** Alex., 1954: PJS, 82:301–2 (*yamamotana*!, ssp.), t: Omogokei (♀); TSES, 3:82 (*yamamotoana*, ssp.) (1953) [nom. nud.].
Dist: JAPAN (Shikoku).

Genus **RHABDOMASTIX** Skuse, 1890

Rhabdomastix Skuse: PLSN, (2)4:828–9; Alex.: MCAS, 25:901, 904 (1919); MCAS, 38:909, 942 (1920) [L; P]; PJS, 49:395 (1932); FG, 50 (1934) [k]; BCSS, 64:425 (1942); Lacks.: ANMW, 50:50 [*Gonomyia*] (1940); Wu: CIS, 5:59–60 (1940); Coe: HIBI, 46, 52–3, f. 18d (lower parts of pleurae, with mid & hind coxae) (1950).
Type: *Rhabdomastix osten-sackeni* Skuse

Subgenus **SACANDAGA** Alex., 1911

Sacandaga Alex.: Ent. News, 22:349–51; PUNM, 44:492, 508 (1913); MCAS, 25:904 [*Rhabdomastix*] (1919); FG, 50 [*Rhabdomastix*] (1934): BCSS, 64: 442 [*Rhabdomastix*] (1942); Lacks.: ANMW, 50: 50 [*Gonomyia*] (1940); Wu: CIS, 5:60 [*Rhabdomastix*] (1940).
Type: *Sacandaga flava* Alex.

R. (S.) angusticellula Alex., 1957: PJS, 85:378–80, IV:34 (w); 37 (h), t: Kurokawa, Echigo (♂).
Dist: JAPAN (Honshu).

R. (S.) atrata Alex., 1924: AESA, 17:436, t: Emimura, Chiba (♂).
Dist: JAPAN (Honshu).

R. (S.) japonica Alex., 1924: AESA, 17:69–70, t: Tokyo (♀); PUNM, 68(4):4 (1925); PJS, 71:51 (1940) [n]; PJS, 82:302, V:45 (w) (1954).
Dist: JAPAN (Hokkaido; Honshu; Shikoku).

R. (S.) microxantha Alex., 1958: PJS, 86:316–7, VI:45 (w); 51 (h), t: Kurokawa, Echigo (♂).
Dist: JAPAN (Honshu).

R. (S.) nebulifera Alex., 1957: PJS, 85:380–1, IV:35 (w); 38 (h), t: Kurokawa, Echigo (♂).
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(*To be continued.*)

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蛋白質（卵アルブミン, ペプシン）及び ポリビニールアルコール単分子膜とコンゴーレッドの結合について

石　井　健　三・岸　本　昇　三

The Interaction of Congo-red with Ovalbumin, Pepsin and Polyvinyl Alcohol Monolayers.

Kenzo Ishii and Shozo Kishimoto

緒　　論

単分子膜法によって物質相互の Interaction を研究することは，最近特に Pankhurst 等のコーラゲン，ゼラチン膜に対するタンニン酸の結合[1]，Holt 等による種々の蛋白膜に対するケイ酸の結合[2]，そして Giles[3]，村松[4] 等による長鎖脂肪酸，及びその誘導体の膜に対する種々の色素の結合等が系統的に研究され工業的に重要な，或は生体内における反応の基礎として興味ある結果が得られている．これらは主として Substrate 溶液の pH を変えて単分子膜の表面圧—面積（F－A）曲線を測定し，その A－pH 曲線，圧縮率等を，結合物質を Substrate 溶液に含む場合のそれに比較し，更に膜物質及び結合物質の状態，構造を推定することにより，両者の間の結合の力，型式等が考察されている．

著者等は先に同様の方法により卵アルブミン膜に対するブロムフエノールブラウの場合の研究を行い，結合の力は主として静電気的なものであることがわかったが[5]，更に今回は卵アルブミン（等電点4.7～4.8），ペプシン（等電点3以下），及び電離基を持たないポリビニールアルコールを単分子膜に，また結合物質にコンゴーレッド（C. R.）を用いた．この色素は直接染料として古くから知られ分子内に酸性（$-SO_3H$），塩基性（$-NH_2$）の両基を有し，しかも会合性の非常に強い物質である．この色素が溶液の pH，塩の濃度等の条件で単分子膜の性質にどの様な影響を与えるかを研究した．

実　　験

表面圧測定の装置，単分子膜の作り方は以前と同様である[6]．試料として硫安法により精製した卵アルブミン，Washington 生化学研究所の 2X－cry. ペプシン，及び重合度約 2000 のポリビニールアルコール（P.V.A.）を用いた．C. R. は Merck 社製のものをそのまま使用した．Substrate 溶液の pH は 2～12，塩（NaCl）の濃度は 0～0.5 M/1 で測定を行った．何れの場合も C. R. の濃度は 0.00075% にした．なお pH の調整は HCl, NaOH のみを使用し，特定の緩衝液は用いず測定後すぐにガラス電極でその pH を測定した．実験はすべて室温で行った．

結　　果

ペプシン．—Substrate 溶液に塩を含まない場合の種々の pH溶液の上に作った単分子膜の F＝1 dyne/cmにおける A－pH 曲線を Fig. 1 に示す．この場合 pH＝4以上では単分子膜はほとんど形成されない．Substrate 液に C.R. を加えることによって pH＝3 の附近で若干その面積が増加している．

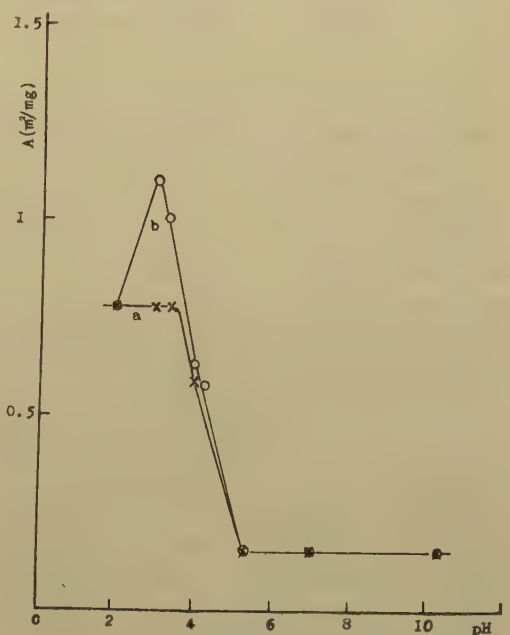


Fig. 1. A/pH curves of pepsin films.
Subsolutions : (a) without dye
(b) 0.00075% C. R.

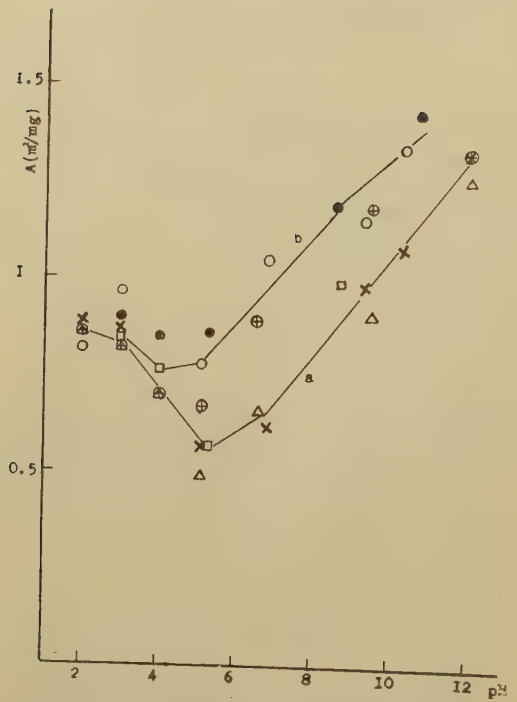


Fig. 2. A/pH curves of pepsin films.

Subsolutions ; —×—0.125 M/1 NaCl
—△—0.25 〃
—□—0.5 〃
} (a) without dye

—○—0.125 M/1 NaCl
—⊕—0.25 〃
—●—0.5 〃
} (b) C. R.

次に塩を含む溶液上では Fig. 2 のような結果になる．0.1 M/1 以上の濃度にすることによって pH＝4 以上の溶液上でも単分子膜は形成され，アルカリ性が強くなるに従って著しく高面積を示すようになる[6]．C. R. の影響は前の時と非常に違って，pH＝3 における面積の増加は減じ，pH＝4 を境として大きくなり強アルカリ性の pH の範囲まで大体一定している．

卵アルブミン．—塩を含まない場合は Fig. 3 に見られる如く等電点を極大として，その両側で極小を示すような A (F＝1 dyne/cm)－pH 曲線となる[5]．この場合 C. R. の影響はペプシンの時とは異って興味ある結果を示す．即ち pH＝4～4.5 の間で面積は極端に増加し，そのアルカリ側では逆に著しく減少する．

塩を添加することによってペプシンの場合と同様にその A－pH 曲線は非常に変り，しかもその塩の濃度の影響を受ける (Fig. 4)．C. R. の効果は，塩を含まない場合に見られた極端な面積の極大や逆に減少するというような現象は見られず，pH＝4 を境にしてそのアルカリ側の広い範囲でほぼ一定した面積の増加が認められる．

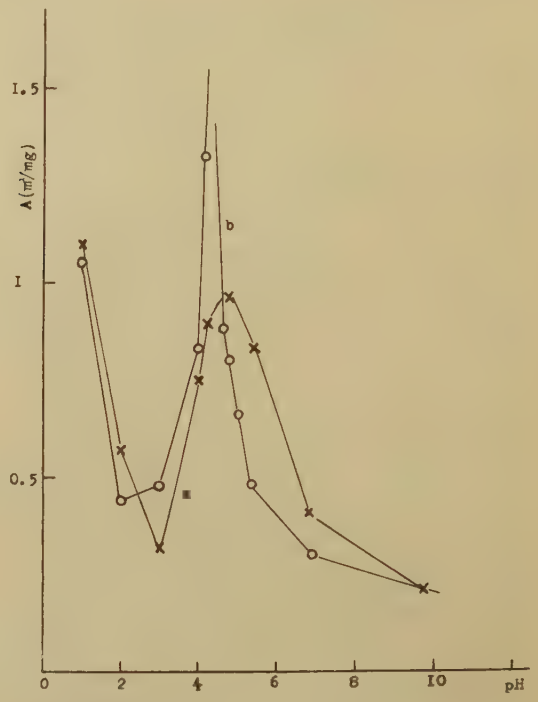
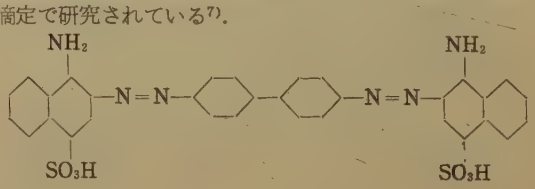


Fig. 3. A/pH curves of ovalbumin films.
Subsolutions : (a) without dye
(b) C. R.

P. V. A. —前述の様な球状蛋白質の膜とちがって，このような糸状ポリマーは特有の著しく Expand した F－A 曲線を示す (Fig. 5)．これは電離基を持たないのでその F－A 曲線は Substrate 溶液の pH，塩の存在によって目立った変化を示さない．各条件において図のようになり，Closed Packing に相当する面積は明かでない．C.R. の存在によって，PH＝4 以上で変化が見られるのは蛋白の時と同様であるが，図の d. e. f. のように塩の濃度によって様々の型の曲線が得られる．即ち塩が存在しない場合は F－A 曲線は Condense するが，塩の濃度が増すに従ってその圧は急激に増加し，明確な Closed Packing の面積を示すようになる．

考　　察

F－A 曲線からは以上の様な結果が得られるが，これ等を説明するために，先ず C. R. が溶液中でとる状態を考える必要がある．この分子が有する電離基，$-SO_3H$，$-NH_2$ それぞれ2個の解離については村松により電位滴定で研究されている[7]．



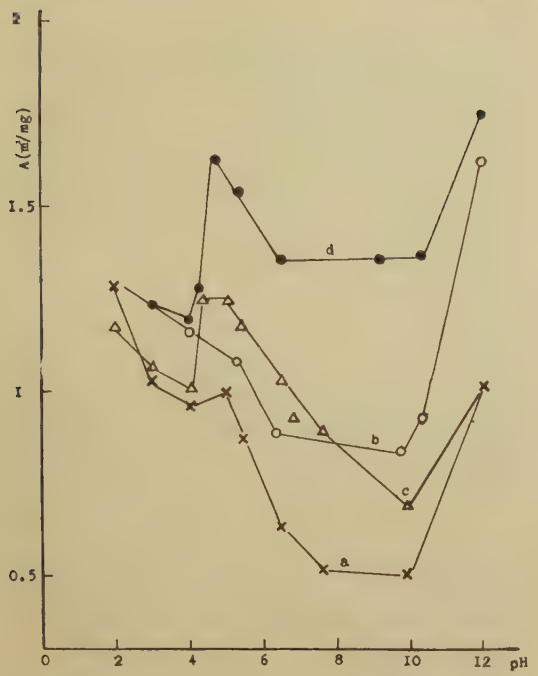


Fig. 4. A/pH curves of ovalbumin films.

Subsolutions: (a) 0.125 M/1 NaCl, (b) 0.5 M/1 〃 } without dye
(c) 0.125 M/1 NaCl, (d) 0.5 M/1 〃 } C. R.

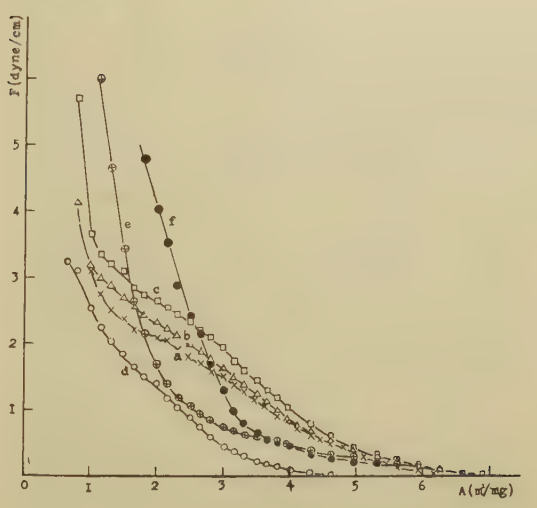


Fig. 5. F/A curves of P. V. A. films.

Subsolutions: (a) no salt, (b) 0.125 M/1 NaCl } without dye
(PH=5.3) (c) 0.5 M/1 NaCl
(d) no salt, (e) 0.125 M/1 NaCl, (f) 0.5 M/1 NaCl } C. R.

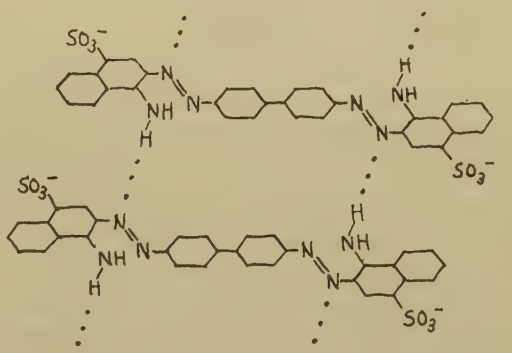
即ち pK として $-SO_3H$ に対し $pK_1=pK_2=2.72$ が，$-NH_2$ に対し $pK_3=5.32$，$pK_4=6.9$ が決定された．これ等の値により C.R. が種々の pH 溶液中で有する電荷についての知識は得られる．

また蛋白質が有する表面の電荷については，Dogan, Glazer の表面電位の測定から，$-COOH$ には大体 $pK=5.0$，$-NH_2$ 基には $pK=11.5$ が与えられている[8]．

C.R. 分子の溶液中における会合性はその pH，塩の濃度に左右される．即ち pH=4 以下においては会合は進み，遂に沈降するにいたる．この傾向は塩の濃度が増すに従って，より著しくなる．このような会合の度合については Valkó, Robinson[9]，中垣[10]等の拡散定数測定から推定され，塩濃度が高い場合は相当巨大な集合体になるものと思われる．特に Rose[11] によって図のような水素結合による型が考えられている．

会合を促進する電解質の効果は $-SO_3H$ 基の解離の抑制或はこれ等の基のまわりに電気二重層を形成して，お互いの分子の接近が容易になるものと説明される．

以上の様な考察をもとにして C. R. の溶液中の状態と単分子膜の構造を検討することによって実験結果を説明する．



単分子膜に C. R. が何らかの Interactionを及ぼすことによって，その面積或は圧縮率等の変化がおこっているとすれば，その力に対して考えられるものは静電気的なもの，van der Waals の力等である．

ペプシンの場合 pH=3 における面積の極大 (Fig.1) は次の如く考えられる．この pH におけるペプシン膜の状態は，解離基の大半を占める $-COOH$ 基の電離がほとんど抑制され (pK=5)，等電点に近いので分子全体の電荷は零に近い．C.R. についても $-SO_3H$ の解離はおさえられてかなり会合が進んでいる (pH=3 以下では沈降する)．従ってお互いの負電荷による反発は減じ，Interaction は主として van der Waals の力による弱

いものであると思われる．またペプシン分子中ににある僅かの正荷電（アルギニン，リジン，ヒスチジン残基各2個）と C. R. の $-SO_3^-$ のイオンとの作用も考えることは出来る．またこれは松浦による C. R. 溶液上におけるステアリン酸膜の場合の面積増加を示す pH と一致している[12]．従ってペプシンに多数存在する −COOH 基の状態が主要な役割を果していることがわかる．

塩が存在する時 pH＝3 において面積の増加が減少する事実（Fig.2）は，C. R. 自体が塩の存在で水素結合或は van der Waals 力等によって益々会合をおこし，表面層から離脱していることを示していると思う．pH＝4 以上の広い pH 域で面積の増加が見られる（Fig. 2）が，この範囲でペプシン膜は分子全体として負の電荷，C.R. は等電状態から負電荷のみを有する状態まで含んでいる．このような状態での Interaction は次の如く考えられる．即ち塩の効果によって両者の負電荷同志の反発は緩和され接近し易くなり，更に C. R. 分子は表面層からの離脱にまでは至らない程度の会合によって大きな集合体を作っている．従って両者の間に van der Waals の力生ずると考えられる．また同時に極部的な正負電荷がによる塩様結合，水素結合等の静電気的な力も予想出来るが，何れも強いものとは思われない．

アルブミンの場合の pH＝4.0〜4.5 における面積の増加，及び pH＝4.5〜10 の間の減少は，アルブミン，C. R. 共にその等電域で，正負電荷を共に有している pH 域で起っている．従って両者の正負の電荷が互いに塩様結合の出来るような都合のよい配置をとるものと相像される．また面積の減少即ち F—A 曲線の Condense となる場合は，充分に表面変性を受けていない不安定なアルブミン膜が C. R. と強固に結合することによって，表面を脱して内部へ溶解するか，或は本来の単分子膜の構造が著しく変化を受けたものと解釈出来る．

塩の存在する場合（Fig. 4）は前のペプシンの場合と大体同様に考えられるが面積の増加の量はこの場合の方がかなり大きい．これはアルブミンの方がペプシンよりも非常に多くの正電荷の基（アルギニン残基15，リジン残基20，ヒスチジン残基 7）を有し，極性が大きく，従って結合能力が大きいと相像出来る．なおこの時は面積の減少は起らない．これは Interaction の機構が違うためか，或は塩の存在で単分子膜自身が安定になっているものと思われる．

P. V. A. の場合に pH＝4 以下で Interaction がないのは蛋白の例と同様であるが，pH＝4 以上で Interaction によってその F−A 曲線は蛋白の時とは非常に違ったものになる（Fig. 5）．また蛋白ではClosed Packing の面積における F−A 曲線の傾斜（圧縮率に関係する）は C.R. との Interaction によってもほぼ等しいが，P. V. A. の場合は著しく変る．これについては次の如く考えられる．溶液上で十分に自由に伸びた Chain の−OH 基に C. R. が水素結合等で網目構造を作りその Chain の屈曲性が束縛をうけて膜は Condense する．更に塩の影響により会合した C. R. のために遂に F−A 曲線は明かな Closed Packing の面積を示すまで固化するものと思われる．

またセチールアルコールの場合では pH＝3 に面積の極大が認められているが[4]，同様に −OH 基をもっていてもこれは P. V. A. の場合とは一致していない．従って Interaction の機構は別のものであることがわかる．

結　　論

1) 蛋白質（卵アルブミン，ペプシン）及び P. V. A. と C.R. との Interaction は一般に pH＝4以上の C. R. の等電域で大きい．

2) 塩（NaCl）の濃度が大きい程一般に Interaction は増大するが，これは解離基の電離に対する影響そして C. R. の会合性の増加によるものであろう．

3) ペプシンの場合を除いて，pH＝4 以下で Interaction がないのは，C. R. 自身が大きく会合することによって表面層から離脱していくものと考える．

4) Interaction の力として主として van der Waals の力，塩様結合等の静電力が，特に P. V. A. の場合は水素結合が重要な役割を持っている．

（物理化学講座，1960年 8 月31日受理）

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Summary

The interaction of Congo-red and monolayers of ovalbumin, pepsin and polyvinyl alcohol, spread at an air/water interface on substrates of different pH and NaCl solutions, has been examined by the technique of surface pressure.

Above pH 4 the change of F－A curves is generally occured provided that the molecule of Congo-red is in zwitter ion form; and as the concentration of salt increases, this effect becomes more pronounced.

Possibly below pH 4 the absence of the interaction is caused by the desorption of Congored molecule from the surface layer to the bulk phase with the exception of pepsin monolayer.

It is considered that this interaction results mainly from the formation of salt links and van der Waals forces and that the case of polyvinyl alcohol, hydrogen bond plays specially an important part.

(Laboratory of Physfcal Chemistry)

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